

Ch. 8 Cellular Energy

Section 8.1 → How Organisms obtain Energy

I. Transformation

A. Chemical reactions + processes are constantly occurring in your cells

1. All of the cells require energy (ATP), the ability to do work

B. Laws of thermodynamics

1. 1st law = law of conservation of energy
 - a. energy cannot be created nor destroyed

2. Entropy, the measure of disorder, or usable energy

C. Autotrophs + heterotrophs (all organisms need energy to live)

D. Metabolism - all of the chemical reactions in a cell

1. Metabolic pathways include two major types:
 - catabolic + anabolic
 - a. Catabolic - release energy; large → small
 - b. Anabolic - use energy to build large molecules from small molecules

2. Photosynthesis - anabolic pathway in which light energy from the sun is converted to chemical energy

3. Cell respiration - catabolic pathway in which organic molecules are broken down to release energy for cell

II ATP: the unit of cellular energy

A. ATP (Adenosine triphosphate) is the most important biological molecule that provides chemical energy

B. ATP is a nucleotide made of an adenine base, a ribose sugar, and 3 phosphate groups

1. ATP releases energy when the bond between the 2nd and 3rd phosphate groups is broken
 - a. $ATP \rightarrow ADP$: yields energy

Bellringer

Cells are made of matter (chemical structures called proteins, carbs, lipids, etc.)

H_2O

CHNOPS

→ What is everything made of?
matter → elements → atoms

→ What are you made of?
 mostly H_2O + CHNOPS (elements)

→ How do cells make energy?
 Fermentation (no O_2) Cell Resp. (Animals + Plants)

→ What is a heterotroph? Photo (only Plants + Photo Bacteria)
 Eats other organisms...

→ What is a food web?
 Complete diagram of feeding interactions in a system
MANY food chains → Food web

Bellringer

→ What is the ultimate source of energy for life?

SUN

→ How is "that" energy converted into a form usable by people? Free Energy

CO_2 → $C_6H_{12}O_6$ → ATP

★ → What is everything made of? ★

Life → Matter → Elements → Atoms → $\frac{P}{N} > \frac{Q}{S}$ Quarks

Bellringer

→ How is photosynthesis related to cell respiration?
Which energy processes do plants use? animals?

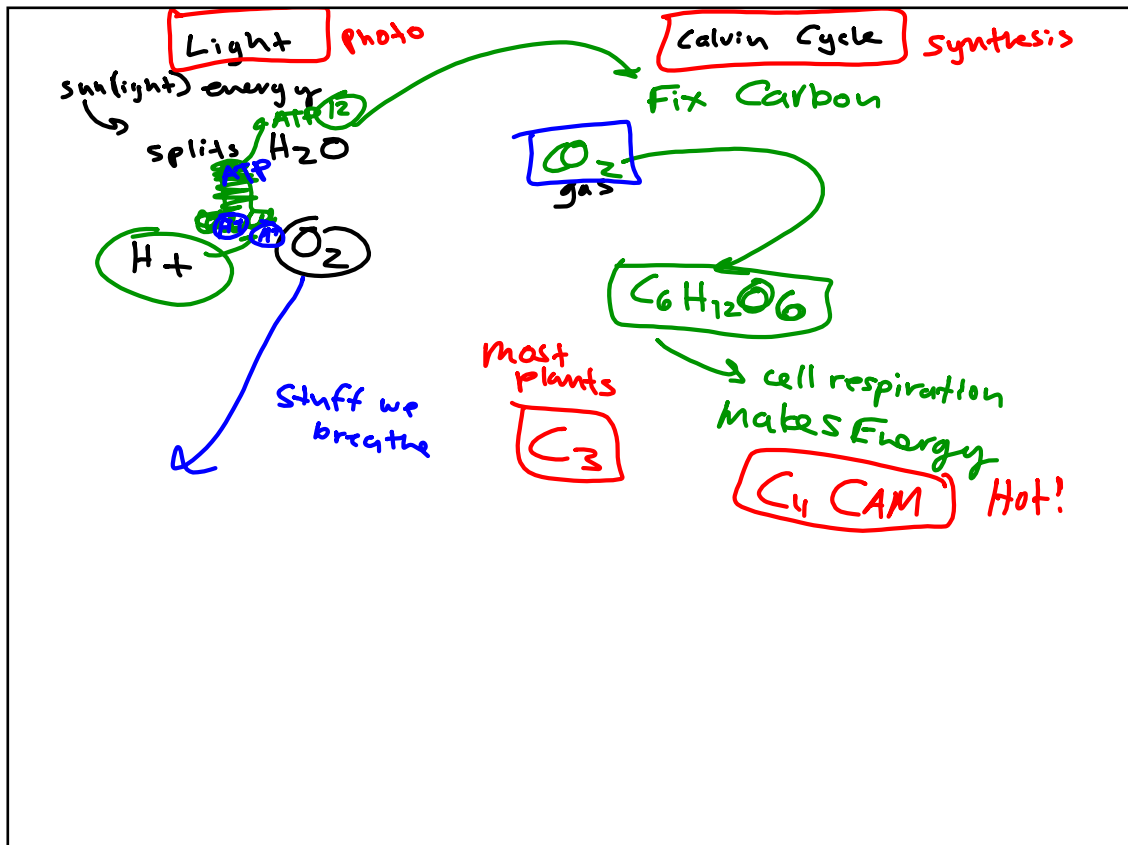


→ What are the first 2 laws of thermodynamics?

1) Energy is not created nor destroyed

2) Entropy (loss of energy (heat) every chemical rxn)

ATP → ADP



Bellringer → No energy

→ How does photosynthesis work? Explain. → makes a sugar
 ★ Draw a diagram ★

→ What is the chemical equation for photosynthesis?

photo
cal
resp

$$\text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{light}} \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$$

→ What is metabolism? No Energy

plants
photosynthesis

$$6 \text{CO}_2 + 6 \text{H}_2\text{O} \xrightarrow{\text{(sun) light}} 6 \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2$$

No energy

cellular resp

$$6 \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O} + \text{Energy}$$

ATP

Photosynthesis

- 1) Light \rightarrow What's produced
 \rightarrow Where \rightarrow makes 18 ATP
 Electron Transport
 uses 18 ATP to fix $\text{CO}_2 \rightarrow$ sugar
- 2) Calvin (Dark) \rightarrow What's produced
 \rightarrow Where

Beltinger

\rightarrow What are the reactants for photosynthesis?

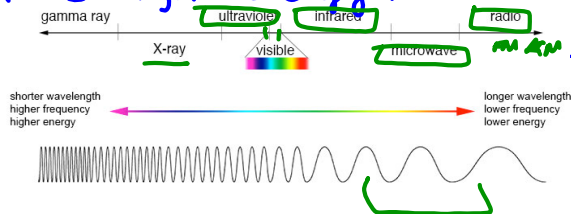


\rightarrow What is light energy's role?
 Radiant \rightarrow chemical energy

\rightarrow What is light energy?

no mass

photon



Light \rightarrow $\text{H}_2\text{O} \rightarrow$ ETC \rightarrow makes ATP
 Dark \rightarrow Sugar from CO_2 rubisco
EM Spectrum
Particle

1 What does the first law of thermodynamics state?

- A entropy increases
- B energy is conserved
- C metabolism decreases
- D chemicals are produced

2 Autotrophs that convert light energy into chemical energy are called _____.

- A heterotrophs
- B chemoautotrophs
- C photoautotrophs
- D omnivores

3 All chemical reactions in an organism's cells are called

_____.

- A chemotrophy
- B autotrophy
- C thermodynamics
- D metabolism

4 What chemical bond in ATP releases when broken down?

- A phosphate
- B sulfur
- C oxygen
- D potassium

5 The second law of thermodynamics states....

- A ability to do work is energy
- B spontaneous increase in disorder, entropy
- C the idea that energy cannot be created nor destroyed
- D catabolic pathways break down organic molecules

J .
, "eq/ run occurs

8.2 Photosynthesis

I. Overview of Photosynthesis energy from sun

A. Equation: $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

B. Occurs in two phases

1. Phase 1 (light - dependent)

a. Electron transport → make energy (ATP)

Rubisco enzyme
CO₂ → usable carbon 2. Phase 2 (light - independent)

b. Calvin Cycle ← use ATP (all)

C. Chloroplasts - disc-shaped organelles that contain two main compartments essential to photosynthesis

1. Thylakoids - flattened, saclike membranes arranged in stacks

a. Stacks are called grana

2. Stroma - fluid-filled space that is outside the grana

D. Pigments - light absorbing colored molecules found in thylakoid membranes of chloroplasts

1. Major light-absorbing pigments in plants = chlorophylls

E. Electron transport (1st step of photosynthesis)

→ know steps of electron transport (p. 453) Figure 10

F. Calvin Cycle (2nd phase of photosynthesis)

→ Figure 11 (pg. 455)

1. Enzyme Rubisco converts inorganic CO₂ molecules into organic molecules that can be used by the cell

a. This is known as carbon fixation
inorganic C → organic C

II Alternative Pathways

- A. Many plants in extreme environments have alternative photosynthesis pathways
- B. C_4 plants - fix CO_2 into 4 carbon compounds instead of 3 in Calvin Cycle
 - 1. minimizes water loss
- C. CAM (Crassulacean acid metabolism) plants
 - 1. Occurs in dry areas where access to water is limited
 - 2. Process allows CO_2 only to enter plant at night when atmosphere is cooler and there is less humidity
 - a. process also minimizes water loss
 - 3. Carbon fixation at night of organic CO_2 molecules then enter Calvin Cycle during day to minimize water loss

Photosynthesis Review

Grade: 10th

- Subject: Biology

· Date:
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photosynthesis

Grade: «grade»

Subject: «subject»

Date: «date»

1 Light absorbing colored molecules called _____ are found in chloroplasts.

A pigments

B stroma

C rubisco

D ATPs

2 Where do light-independent reactions occur during photosynthesis?

- A mitochondrion
- B stroma in vacuoles
- C nucleus
- D stroma in thylakoids

3 What occurs in the second phase of photosynthesis?

- A chemiosmosis produces ATP
- B light absorbed
- C light is converted into ATP
- D glucose is made from ATP



4 Which of these statements is true regarding chlorophyll?

- ☒ A it is not the only photosynthetic pigment
- ☐ B there is only one kind of chlorophyll
- ☐ C it is the only type of pigment in leaves
- ☐ D it is the rarest type of pigment in leaves

5 Rubisco is the enzyme that converts inorganic carbon dioxide into organic carbon dioxide that can be used during the Calvin cycle.